BRIEF REPORT

Preparing for a Foreign Animal Disease Outbreak Using a Novel Tabletop Exercise

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Abbreviations:
AI: avian influenza
COB: Continuity of Business
FAD: foreign animal disease
HPAI: highly pathogenic avian influenza
LPAI: low pathogenicity avian influenza
PIN: Premises Identification Number
SFS: Secure Food Systems
US: United States
USDA: US Department of Agriculture

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Abstract

Introduction: Foreign animal disease (FAD) outbreaks can have devastating impacts, but they occur infrequently in any specific sector anywhere in the United States (US). Training to proactively discuss implementation of control and prevention strategies are beneficial in that they provide stakeholders with the practical information and educational experience they will need to respond effectively to an FAD. Such proactive approaches are the mission of the Secure Food System (SFS; University of Minnesota; St. Paul, Minnesota USA).

Methods: The SFS exercises were designed as educational activities based on avian influenza (AI) outbreaks in commercial poultry scenarios. These scenarios were created by subject matter experts and were based on epidemiology reports, risk pathway analyses, local industry practices, and site-specific circumstances. Target audiences of an exercise were the groups involved in FAD control: animal agriculture industry members; animal health regulators; and diagnosticians. Groups of industry participants seated together at tables represented fictional poultry premises and were guided by a moderator to respond to an on-farm situation within a simulated outbreak. The impact of SFS exercises was evaluated through interviews with randomized industry participants and selected table moderators. Descriptive statistics and qualitative analyses were performed on interview feedback.

Results: Eleven SFS exercises occurred from December 2016 through October 2017 in multiple regions of the US. Exercises were conducted as company-wide, state-wide, or regional trainings. Nine were based on highly pathogenic avian influenza (HPAI) outbreaks and two focused on outbreaks of co-circulating HPAI and low pathogenicity avian influenza (LPAI). Poultry industry participants interviewed generally found attending an SFS exercise to be useful. The most commonly identified benefits of participation were its value to people without prior outbreak experience and knowledge gained about Continuity of Business (COB)-permitted movement. After completing an exercise, most participants evaluated their preparedness to respond to an outbreak as somewhat to very ready, and more than one-half reported their respective company or farms had discussions or changed actions due to participation.

Conclusion: Evaluation feedback suggests the SFS exercises were an effective training method to supplement preparedness efforts for an AI outbreak. The concept of using multi-faceted scenarios and multiple education strategies during a tabletop exercise may be translatable to other emergency preparedness needs.

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Introduction

The introduction of a foreign animal disease (FAD) in the United States (US) has the potential to be devastating. This is due to the high costs to control and eradicate the disease as evidenced with previous FADs.[1-3] For example, the 2014-2015 highly pathogenic avian influenza (HPAI) outbreak in US poultry was estimated to have cost US$3.3 billion to the national economy.[4] However, FAD outbreaks are not common in the US, and they usually affect only a specific region or commodity. In the poultry industry, for instance, there have been just seven FAD outbreaks in the US between 1971 and 2017, with many of these occurring in different regions.[1,3,5-7] If a region has experienced multiple outbreaks, the

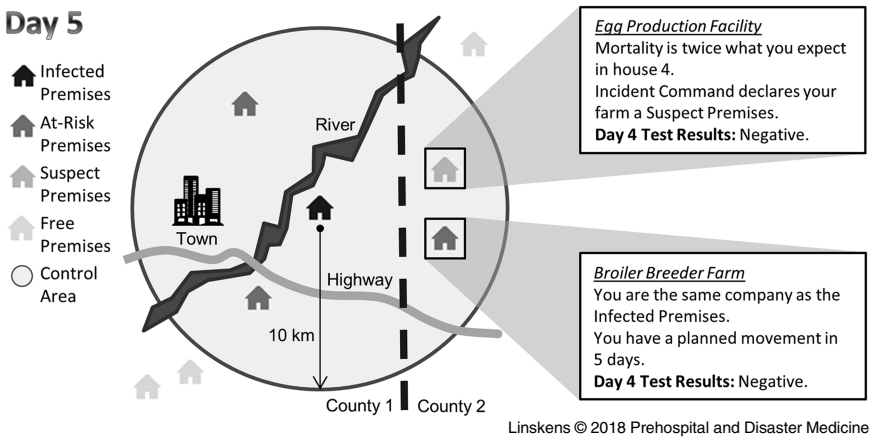

Figure 1. Examples of On-Farm Situations from an HPAI Outbreak Scenario of an SFS Exercise. Abbreviations: HPAI, highly pathogenic avian influenza; SFS, Secure Food Systems.

significant timespan between outbreaks may result in a lack of historical context for outbreak management as those with personal experience retire or leave the industry. Without proper training or prior experience, response personnel may lack specific knowledge of critical activities or complex mitigation strategies that require rapid action in an outbreak.[8] Decision making in an FAD outbreak can have high consequences on disease control and thus will impact its severity.

In 2007, the US paradigm for managing premises with susceptible animal species within an FAD Control Area without evidence of infection but affected by the disease response changed with the inclusion of Continuity of Business (COB).[9,10] While helpful for controlling outbreaks, quarantine and movement controls put in place in a Control Area can lead to unintended consequences that may include, but are not limited to, economic and animal welfare concerns because animals and animal products may not move within marketing channels during an outbreak.[11] Continuity of Business provides a way for premises not known to be infected but located inside a Control Area to continue animal and product movements through market channels by applying risk-mitigation strategies for managed movement.[12] The Secure Food Supply plans, namely the Secure Egg Supply, Secure Turkey Supply, Secure Broiler Supply, Secure Milk Supply, Secure Pork Supply, Secure Beef Supply, and Secure Upland Gamebird Supply plans, aim to provide risk-based movement guidance that preserve COB in the context of disease control.[13] The proactive approach to develop and optimize science-based movement and risk-mitigation strategies across commodities is the focus of the Secure Food System (SFS; University of Minnesota; St. Paul, Minnesota USA). The overarching goal of the SFS is to facilitate movement of animals and animal products during an FAD outbreak, while managing the risk of disease spread. Continuity of Business practices and some of the SFS approaches were first used in the 2014-2015 HPAI H5N2 outbreak, resulting in poultry and poultry product movements that did not appear to perpetuate the outbreak.[14] This experience also demonstrated the importance of proactively engaging those at a regional-level to adopt COB principles. In an outbreak, it is largely the local animal agriculture industry that is required to take actions, along with the state animal health officials who make permitted movement decisions. It is critical these parties are prepared for their roles in COB operations to allow for managed movement during an FAD outbreak.

When an FAD outbreak occurs, preventing expansion of the outbreak requires a multi-agency and multi-sector coordinated response that necessitates a drastic change from how these groups traditionally interact.[15] Trainings to practice outbreak responses, including the complex coordination among industry and government agency partners, are valuable to minimize an outbreak's negative impacts and ensure the safety and the well-being of people and animals. Tabletop exercises used as discussion-based sessions for emergency personnel in a crisis scenario have been previously implemented in preparation for animal disease outbreaks.[16–18] Tabletop exercises should allow for a close replication of an FAD control effort to provide a valuable learning environment. The objective of this project was to develop exercises for regional or company trainings where response protocols can be learned and practiced for both infected and uninfected premises in a realistic outbreak scenario.

Methods

SFS Exercise

Scenario Development—The FAD outbreak scenarios reflect previous outbreak experiences collected from personal communications with state and federal regulators, poultry veterinarians, and producers involved in the following outbreaks in the US: 2002 Exotic Newcastle Disease, 2014-2015 HPAI H5N2, and 2016 HPAI/low pathogenicity avian influenza (LPAI) H7N9. To add realism, a local collaborator or group of collaborators provides input on the types of production facilities typical of the region. From this information, fictional animal agricultural premises, routes of transport, and processing plants are created. Maps are created that mimic regional layouts of poultry production, including farm density and proximity to roads and towns.

In the scenario, fictional premises are located within a region, connected through a production system, or by processing linkages. Each premises is given a fictitious Premises Identification Number (PIN) akin to the National PIN, and the characteristics of the animals on the premises (eg, age of animals and flock or herd size), management strategy, and typical movements are provided. Animal agriculture industry participants are assigned to a group seated together at a table, representing these premises and reflecting their own farm experience and knowledge. For example, a table designated as an egg farm may have five to eight attendees from companies that produce eggs and a table moderator. Events are scripted for each premises to create multiple unique, on-farm events.

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Target Audience—An exercise is targeted for the multiple partners involved in FAD control and prevention: animal agriculture industry members; state veterinary laboratory diagnosticians; and state and federal animal health regulators. Regulator roles include the Incident Commander, state permitting authorities, and federal resource managers from regional US Department of Agriculture (USDA; Washington, DC USA)-Animal and Plant Health Inspection Service-Veterinary Services (APHIS-VS; Riverdale, Maryland USA). Each partner serves a unique role in an outbreak, including the implementation of COB-permitted movement.[8,12,19] Additional participants in some SFS exercises have come from the USDA Food Safety and Inspection Service (FSIS; Washington, DC USA), US Department of Homeland Security (Washington, DC USA), and academic institutions.

Conducting an SFS Exercise

The fictitious FAD scenario unfolds through daily announcements from the state regulatory authority and maps are displayed to convey regional outbreak updates. The on-farm scenarios at each table are portrayed by the moderator reading the premises' daily events over seven to eight scenario days.

Scenario Response—In an exercise, participants apply previous knowledge and their actual job responsibilities to emergency response, disease prevention, and animal production. Industry participants are instructed to collaboratively "run the farm" that their table represents by responding to their particular on-farm situation within the larger FAD outbreak scenario (Figure 1). Tables with farms that are located inside a Control Area need to figure out how to move product following COB-permitted movement guidance and state requirements, as regulators and diagnosticians play their respective disease response roles (Table 1). Industry participants can practice a simplified process to test their flocks/herds for disease by carrying tokens that represent test samples to the table of laboratory diagnosticians. The tokens from each scenario day are collected separately to help convey the potential workload that a laboratory would need to manage during an outbreak. Occasionally, a fictional farm is scripted to become an Infected Premises. In that event, an assigned agency case manager joins the table to discuss disease containment with participants.

Strategies to Deliver Information—The intention for an SFS exercise is to introduce and maintain a sense of chaos among the participants as they run their farms to simulate the challenges of a real FAD outbreak. And as in a real outbreak, participants must navigate an emotional situation to solve problems and make decisions based sometimes on incomplete information. To guide the tables and individual participants, a variety of approaches are used.

Table moderators facilitate discussion among industry participants and provide one-on-one instruction based on experience, expertise, and the aid of a moderator script. Moderators prompt participants to synthesize and expand upon the information they are receiving to evaluate risk to their fictional farm. For example, it is important for participants to understand the infection dynamics in a herd or flock. More specifically, when a herd or flock has increased mortality, disease detection is relatively straightforward and the amount of virus being shed by the infected animals is high. In contrast, disease detection would be difficult in herds or flocks with no overt clinical signs of disease and the amount of virus shed by infected animals would be low. To emphasize the importance of these differences, the moderator's script would have the moderator and participants discuss the relationship between clinical signs and the amount of virus shed by an infected herd or flock so they can understand the impacts of the type and timing of their actions on potential disease spread.

Participant	[a]Possible Roles in COB during an FAD Outbreak [b]Possible Roles during an SFS Exercise
Animal Agriculture Industry	[a]Implement criteria for permitted movement. Request permit and document permitted movements.[12]
	[b]Implement criteria for permitted movement. Request permit and document permitted movements.
Permitting Authority (State)	[a]Review permit request to approve or deny permitted movement.[12]
	[b]Review exercise documentation related to permit requests provided by tables to approve or deny permitted movement.
Veterinary Laboratory Diagnostician	[a]Perform diagnostic tests on samples and report test results. Meet surge requirements. Provide direction to responders on sampling and processing.[19]
	[b]Provide direction on sampling procedures. Review sample submission and processing. Evaluate surge requirements for diagnostic testing.
Incident Command	[a]Manage regulatory Control Area(s) and response activities of an FAD outbreak.[12]
	[b]Address questions of disease control and outbreak status, and review requests for COB operational permits to approve or deny movement.
USDA APHIS VS (Federal)	[a]Oversee interstate permitted movement and movement related to international trade, and be prepared to support State (s) in permitting.[12]
	[b]Engage in table-level discussion or oversee regional response to scenario.

Table 1. Roles of SFS Exercise Participants in COB-Permitted Movement

Abbreviations: COB, Continuity of Business; FAD, foreign animal disease; SFS, Secure Food Systems; USDA APHIS VI, US Department of Agriculture-Animal and Plant Health Inspection Service-Veterinary Services.

Informational sessions interrupt table-level discussions during the scenario outbreak to provide brief lectures on concepts relevant to outbreak response. These lectures often coincide with newly released information or provide timely guidance at a particular decision point for a farm. For example, a farm with an epidemiological link to an infected farm may receive the designation of "Contact Premises." If this happens in the scenario, then an informational session providing an overview of possible premises designations in an FAD outbreak would be given to the entire audience.

Resources for outbreak responses are available at each table that include: applicable state regulations and protocols; submission forms

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No.	Date	Training	Focus
1	December 2016	State-Wide	COB permitting in an HPAI outbreak
2	January 2017	Company-Wide	Company responses in an HPAI outbreak
3	February 2017	Multi-State[a]	Responses at onset of an HPAI outbreak
4	February 2017	State-Wide	COB permitting in an HPAI outbreak
5	February 2017	Company-Wide[a]	Company responses in an HPAI outbreak
6	March 2017	State-Wide	COB permitting in an HPAI outbreak
7	March 2017	Company-Wide	Company responses in an HPAI outbreak
8	April 2017	Multi-State	COB permitting in an HPAI outbreak
9	May 2017	State-Wide	COB permitting in an HPAI outbreak
10	June 2017	State-Wide	Responses to an HPAI/LPAI outbreak
11	October 2017	State-Wide	Responses to an HPAI/LPAI outbreak

Table 2. Overview of the SFS Exercises Conducted in the US from 2016 to 2017
Abbreviations: COB, Continuity of Business; HPAI, highly pathogenic avian influenza; LPAI, low pathogenicity avian influenza; SFS, Secure Food Systems; US, United States.
[a] Outbreak scenario was abbreviated.

for the state's diagnostic lab; and permitted movement documentation. Specifically, there are forms with the data elements of a permit request reflecting the USDA's Emergency Management Response System (EMRS) data needs, permit guidance from the Secure Food Supply plans (available for HPAI on the Secure Poultry Supply website), and the state permitting authority.[20] Participants are encouraged to use the materials on-hand to gain awareness of these recommendations and processes.

SFS Exercise Evaluations

Interview requests were distributed electronically to randomized poultry industry participants and selected table moderators from four of the 11 SFS exercises held (Table 2). These exercises were the first four trainings to use the full exercise design described herein. Industry participants were defined as employees of an animal agriculture company with knowledge of the operations on a single or multiple premises. Randomization of participants was done using Microsoft Excel (Version 14.0.7190.5; Microsoft Corporation; Redmond, Washington USA). Requests were sent sequentially until 20% of the participants from an SFS exercise were interviewed. The table moderators (n = 2) selected were those moderators who participated in at least two of the four SFS exercises under evaluation. Requests were made 60 days after completion of an exercise and all interviews occurred over the next 35 days. Interview guides consisting of demographics and open- and closed-ended questions, including Likert scales, were used to implement semi-structured interviews.[21] Interviews occurred by phone or in-person and were not audio-recorded. One individual conducted all interviews and that same individual transcribed the responses.

The Likert scale evaluating usefulness of participation in an SFS exercise ranged from one (not useful) to five (very useful). The Likert scale evaluating the realism of the outbreak scenarios ranged from one (not like a real FAD) to five (exactly like a real FAD).

Summary descriptive statistics were performed on responses to closed-ended demographic questions and the above Likert scales from industry interviews. Responses to all other evaluation questions were aggregated in Microsoft Excel using a modified inductive approach to determine primary codes.[22] The key selective codes for industry responses were: (1) utility of attending an SFS exercise; (2) techniques of the SFS exercises; and (3) outbreak-preparedness-related after participation. Evaluation of the scenario realism was based on responses from industry participants with prior FAD outbreak experience. The key selective code for moderator responses was related to the role of the table moderator in the SFS exercises. Further analysis used a modified grounded theory approach to sub-categorize feedback and identify themes among secondary codes.[23]

The interviews were designed specifically as program evaluation and did not meet either the Department of Health and Human Services (DHHS; Washington, DC USA) or Food and Drug Administration (FDA; Silver Spring, Maryland USA) definition for human subjects' research. Therefore, the protocol did not require Institutional Review Board review.

Results

SFS Exercises Conducted

Eleven SFS exercises were conducted from December 2016 through October 2017 in the Midwestern, Mid-Atlantic, Southeastern, and Western regions of the US. Nine scenarios were modeled after the Eurasian/North American HPAI outbreaks resembling the 2014-2015 US HPAI outbreak in commercial poultry operations. Co-circulation of HPAI and LPAI were the basis of two scenarios, using information from the 2016 and 2017 H7 HPAI/LPAI outbreaks in the US. The SFS Exercises were conducted as company-wide, statewide, or regional trainings (Table 2).

SFS Exercise Evaluations

A total of 15 interviews were conducted. Participants interviewed were those from single state trainings, a regional training, and a company training. Thirteen were with poultry industry

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Demographic Category	Interviewee Response	n
Poultry Industry Sector	Layer (chicken)	7
	Turkey	3
	Broiler (chicken)	1
	Upland Game Bird	1
Job Position	Management	7
	Ownership	2
	Veterinarian	1
	Other	1
Oversight	Multiple Premises	10
	Single Premises	1
Region	Midwest	9
	West	6
	South	3
Previous FAD Outbreak Experience	Yes	7
	No	5

Table 3. Demographic Information of Poultry Industry Participants Interviewed for Evaluation
Abbreviation: FAD, foreign animal disease.

participants and two were with table moderators. Industry interviewees were from diverse sectors of the poultry industry. Seven had FAD outbreak experience, including involvement with positive and/or negative farms; most often they had experience including both (Table 3). Respondents held or would hold a variety of roles in FAD outbreaks, with several indicating complete or partial responsibility for a company response, and they had previously participated in a variety of emergency preparedness activities. The two moderators had extensive experience with poultry disease outbreak preparedness and response planning.

SFS Exercise Utility—Interviewed participants generally found attending an SFS exercise to be useful. On a five-point Likert scale, 10/11 respondents scored the usefulness of the experience as either four or five. Frequently, the participants reported that knowledge was gained about COB-permitted movement. Many interviewees found the exercises to be especially valuable for those with no prior outbreak experience; this was heard directly from and about those participants. Respondents with outbreak experience reported the SFS exercise was a helpful way to provide a refresher for disease response. Several noted an exercise allowed for communication or collaboration within a company or between different response groups. When asked how an SFS exercise could be more beneficial, attendees responded that they would prefer additional instruction on response options during the scenario. Others expressed an interest in operations-based or in-depth training for specific outbreak roles and encouraged additional participation from industry, state government, and a representative for mortality management.

Outbreak Scenario Realism—Among interviewees with FAD outbreak experience (n = 7), the scenarios were generally viewed as realistic outbreak simulations. On a five-point Likert scale, five of six respondents rated the scenario realism a four or five. Aspects of the outbreak scenarios mentioned as realistic by at least two interviewees included the timeline of scenario outbreak events and the scripted events occurring on the fictional premises. When responding to the scenario, two found themselves having similar thought processes in the scenario compared to their experiences in a past outbreak. When asked how the outbreak scenarios could be more realistic, participants most commonly reported some aspects of the SFS exercise were artificial or overly simplified relative to real outbreak procedures or previous outbreak experience.

SFS Exercise Interactions—Most participants found the table moderators helpful, with several commenting that the moderators encouraged critical thinking or provided hints for response decisions. Many stated that simulating the diagnostic sampling process to detect disease added a tangible element to the exercise. The difference in workload between the use of tokens during the scenarios and the real diagnostic sampling process during an outbreak was also noted. Some interviewees, including several without FAD outbreak experience, mentioned they were confused by the resources provided at the tables. Informational sessions during the scenario were valuable for many, but they were particularly useful for those participants of state or regional trainings. Of note, when asked to evaluate how an informational session was used, one participant expressed it led to an increased attentiveness in implementing mitigation strategies prior to the movement of animals.

Post-Exercise Preparedness—Many interviewees reported the experience of an SFS exercise led to discussions or action items at their respective farms or company post-participation. Several attending companies that reported no policy change afterwards cited that their companies already had current disease response plans. Some attendees reported how an SFS exercise was helpful to identify critical aspects about permitted movement procedures that were not previously known. Of note, an on-farm biosecurity practice was changed at the farm of one interviewee after learning about a risk factor for infection related to that practice. Also, the limited capacity of a state's veterinary diagnostic laboratory was discussed during an SFS exercise. After participation, most interviewees evaluated their feeling of readiness to respond to an outbreak as somewhat to very ready, with preparedness levels reported similarly for managing farms inside or outside an FAD Control Area. Some reported that an SFS exercise was an introduction to emergency preparedness, and two acknowledged how different situations may occur in an outbreak than those presented in the scenario outbreak.

Moderator Role—Each interviewed moderator reported that moderator scripts were helpful for facilitating discussion at the table and suggested providing even more prompts to further enhance participant engagement. Of note, one interviewee commented that moderators should encourage communication between tables so that representatives from different poultry industry sectors could discuss regional, cross-commodity disease responses. Each described their method of guiding the table while

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promoting problem solving among participants. For example, one reported that he "push[ed] the participants to develop their own approach: 'Disaster has hit, what are you going to do?'" They found that their experiences in extension, adult education, past outbreaks, and their knowledge of COB plans were beneficial to them in the moderator role. Instructional preparation for moderators prior to an SFS exercise was recommended under select circumstances. Providing positive feedback to table participants and having credibility because of direct knowledge or experience were deemed valuable characteristics for a moderator.

Discussion

Opportunities to practice disease prevention, control, COB strategies, and formation of working teams are critical to prepare for and respond to FAD outbreaks. Though it is difficult to predict what future FAD outbreaks may look like, any outbreak will involve decision makers evaluating the information at-hand to implement mitigations. This need for realistic practice scenarios was highlighted after the 2014-2015 HPAI H5N2 outbreak in the US.[15] An SFS exercise provides a platform for poultry industry stakeholders to work through an outbreak response by placing them in fictional on-farm situations. Several broad themes emerged from the feedback collected. First, participation in an SFS exercise can help offer a sense of experience for confidently responding to a future outbreak. Second, participants frequently expressed a preference for additional detailed instruction to help them respond to the presented disease scenarios. It is important to note that this level of detailed instruction will likely not be available during an FAD outbreak. Therefore, an SFS exercise uses a balance of guiding response, yet requiring participant-led decision making. These trained participants, who may have responsibilities in future outbreaks, can then be more prepared.

Permitted movement in an FAD outbreak requires the coordination of multiple groups working together toward a singular goal of safely moving product, yet maintaining the necessary disease control. Most of the SFS exercises that were evaluated focused on COB permitting, and many poultry industry interviewees expressed an increased understanding of it. Practicing the permitting process alongside the specific regulatory officials who will likely be working together during an FAD outbreak was a valuable training tool. For a region to be ready to adopt COB principles, it is also important to develop permitted movement planning and practice operations-based trainings. In the future, the SFS exercises may be useful for state and industry stakeholders to understand COB during other types of FAD outbreaks in other industries, such as foot and mouth disease in livestock. More generally, the design of an SFS exercise is flexible such that content and objectives can be altered allowing for an expansion of their use for all-hazards approaches of emergency response.

Limitations

There can be variability in the effectiveness of tabletop exercises for participants, and tabletop exercises are discussion-based only. Thus, response procedures may not be implemented fully, especially when a physical response is required. The evaluation findings have limitations due to sample size and selection bias. Furthermore, there is no way to effectively quantify the level of preparedness needed for an outbreak; therefore, the level achieved due to SFS exercise participation remains unknown. Finally, several interviewees found it difficult to separate the exercise design from their personal experiences and response protocols. Due to the emotions associated with such experiences, some responses were also emotional.

Conclusions

Despite limitations, poultry industry participant feedback suggests the SFS exercises were an effective training method to supplement preparedness efforts for an avian influenza (AI) outbreak. The concept of using a multi-faceted scenario (eg, on-farm situations in a simulated AI outbreak involving multiple premises) and multiple education strategies during a tabletop exercise may be translatable to other emergency preparedness needs.

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